

**Implementation Guidance for DOE 5400.5, Section II.3
(Management and Control of Radioactive Materials in
Liquid discharges and Phaseout of Soil Columns).**

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Implementation Guidance for DOE 5400.5, Section II.3
(Management and Control of Radioactive Materials in Liquid discharges
and Phaseout of Soil Columns).

1.0 General:

Section II.3 of DOE 5400.5 is a key element of the Order that provides for control of radionuclides in liquid effluent, and for protection of the public and the environment with respect to radionuclides in surface and ground water. A number of questions regarding implementation of the selected requirements contained in Section II.3 have been raised. Typically, questions relate to which paragraphs in DOE 5400.5.II.3 apply to various surface or ground water. This guidance is intended to provide a general response to these questions and to provide specific guidance with regard to the applicability of each paragraph.

Section II.3 can be subdivided as follows:

- II.3.a - Provides for the protection of **surface waters**. This section is intended to control releases to surface waters in a manner that is consistent with Section 301(b) of the Clean Water Act (CWA). EPA regulation 40 CFR Part 125 requires use of the Best Available Technology (BAT) for National Pollutant Discharge Elimination System (NPDES) Permits to control discharges of non-radioactive pollutants to surface waters. In order to provide a consistent level of protection, DOE has incorporated BAT into Section II.3.a of DOE 5400.5.

- II.3.b&c Provide for protection of **ground water and soil**. The U.S. General Accounting Office (GAO) report GAO/RCED-86-192, September, 1986, recommended that DOE establish a ground water and soil protection strategy for facilities under its control. In response to this

recommendation. DOE 5400.1 includes requirements for DOE facilities to establish ground water protection plans and monitoring programs. Sections II.3.b and II.3.c of DOE 5400.5 supplement these activities by providing requirements intended to protect ground water.

II.3.d Provides protection from discharges to sanitary sewerage systems. This section includes requirements consistent with, but more extensive than, those of the Nuclear Regulatory Commission (10 CFR Part 20) which ensure that discharges of small quantities of radionuclides to sanitary sewers do not result in significant radiation dose to the public or to sewerage plant workers.

II.3.e Provides for a mechanism to establish interim control strategies when compliance with other sections of II.3 is not possible. This section also exempts tritium from BAT requirements but requires that tritium releases be evaluated under the ALARA process.

2.0 Surface Water Protection, DOE 5400.5, Section II.3.a

2.1 Requirements:

Section II.3.a applies to all DOE liquid discharges containing radioactive material. It requires that all DOE discharges¹ containing radionuclides in concentrations greater than the Derived Concentration Guides (DCG) in Chapter III of 5400.5, be treated with

¹ Discharges in this section relate to liquid effluent treated or untreated, where the concentration of radionuclides has been increased as a result of DOE activities. It does not for instance, apply to seeps from ground-water to surface waters. If ground-water has been contaminated with radionuclides by previous activities, the water should be monitored, controlled and, as appropriate, remediated in accordance with Chapter IV and Section II.c of DOE 5400.5 and other applicable regulations -- such as those issued under CERCLA or RCRA. However, if interim control strategies permit continued use of soil columns and those discharges are causing seeps that are releasing radionuclides to surface waters in concentrations such that the criteria that require BAT selection are exceeded, then the BAT and ALARA analyses used as the justification for continued interim use of the soil columns must consider the surface water discharges including those from the seeps and associated potential doses when control options are evaluated.

Best Available Technology (BAT) in order to reduce emissions. Requirements and considerations for BAT selection are specified in Section II.3.a(1).

BAT analysis is not required when concentrations at the point of discharge are below the DCGs. However, such discharges are still subject to DOE 5400.5 ALARA requirements² and must be controlled to levels that are as far below the applicable dose limits as is reasonable on the basis of the ALARA process.

EH recommends that, as a best management practice, the BAT selection process be applied and discharges be treated by BAT even when not required by the Order if:

- 1) The total annual effective dose equivalent (EDE) to any member of the public exceeds 10 mrem EDE (0.1 mSv) or the annual collective dose exceeds 100 person-rem EDE (1 person-Sv) and the liquid discharge is a major contributor to either of those doses (e.g., 40% of individual or collective doses), or
- 2) The facility's radionuclide discharges have significant potential to cause downstream water treatment facilities to exceed the radionuclide drinking water Maximum Contaminant Levels in 40 CFR Part 161 .

In order to prevent build up of radionuclides in sediment II.3.a(4) contains limits for settleable solids. Section II.3.a(5) provides a dose limit for protection of aquatic animal organisms. While the Order references guidance in the DOE 5400 series related to measurement, monitoring and dose calculation, the appropriate reference is the DOE "Environmental Regulatory Guide for Radiological Effluent Monitoring and

² DOE 5400.5 is quite clear on the application of DCGs to DOE discharges. The DCGs are only provided as a tool for estimating doses and for screening operations regarding the need for a BAT analyses. DCGs are not release limits (in contrast to the concentration limits in 10 CFR Part 20). All discharges must be controlled in accordance with the ALARA process to doses that are below the 100 mrem in a year primary dose limit or applicable secondary dose limits.

Environmental Surveillance", DOE/EH-173T. Section 5.10.4, page 5-32, of DOE/EH-173T provides guidance for complying with the sedimentation provisions of DOE 5400.5 and Section 8.6 discusses dose to native aquatic organisms.

All new facilities must employ the BAT selection process required in Section II.3.a.

2.2 Point of Compliance:

In general, the point of compliance for determining if the BAT selection process must be employed is the undiluted outfall of the waste stream. If the concentration at the outfall is greater than the DCGs, the use of BAT is necessary. This is the point at which the liquid effluent stream enters the environment, not the site boundary. The intent is to ensure that dilution with other low concentration and high volume streams does not preclude application of BAT.

Facility operators should employ best management practices when making BAT determinations. In situations where discharge into a stream could cause increased radionuclide concentrations (derived from past DOE radiological activities) downstream of the discharge point, the determination for the need to apply the BAT selection process should consider the concentrations at a downstream location prior to the stream entering another surface-water body which would dilute the stream or at the point where the stream leaves the DOE controlled area. For example, if discharge of BAT treated effluent into a previously contaminated stream or drainage ditch could cause the effluent to increase DOE-derived radionuclide concentrations to levels that exceed DCGs prior to dilution resulting from mixing with another source (or exceed either of the two supplemental criteria for BAT recommended above), the effluent stream should be considered for the BAT selection process as part of the review for the facility. Under this review, alternatives to mitigate resuspension of radionuclides should be considered. These same considerations should be employed when ALARA analyses are being

evaluated. In the example considered, an alternate discharge point or piping of the effluent might be considered as control alternatives in the ALARA process.

When calculating and reporting potential doses to the public in compliance with DOE 5400.1 and DOE 5400.5 (Section II.6) requirements, all releases including the resuspension of radionuclides must be evaluated if they could constitute a significant fraction of the dose³.

3.0 Ground Water, DOE 5400.5, Section II.3.b and II.3.c

3.1 Requirements:

These sections enhance protection of ground water and require use of soil columns⁴ to control the release of radionuclides be discontinued. Continued use of current soil columns is permitted as an interim control measure only if facilities have completed a plan and schedule for selecting and implementing an alternative approach at the earliest practicable time. If the period of interim use is indefinite, BAT must be applied to a waste stream containing process-derived radionuclides. As noted previously in footnote 1, the BAT selection process and ALARA analyses supporting continued interim use of a soil column must consider impacts to the surface water as well as soil and ground water

³ The definition of significant should be based on an analysis of the site-specific conditions and the total dose estimates for the site. For example, if estimated doses to a member of the public are between 1 and 10 mrem in a year, doses in excess of 10% of that dose may be considered significant. However, if total doses to the exposed individual are significantly below 1 mrem, doses from this pathway may be as high as 50% the total dose before they would be considered significant.

⁴ Soil columns are trenches, cribs, ponds and drain fields that are used to retain, by sorption or ion exchange, suspended or dissolved radionuclides contained in the liquid waste stream. Surface drainage systems that contain residual radionuclides resulting from DOE discharges to surface waters are not soil columns. Control of radionuclides and determinations regarding continued use of such drainage areas should be accomplished in accordance with the requirements in DOE 5400.5 Section II.3.a and the guidance provided in the previous section of this guidance. The determination of need for remedial action to remove or control radionuclides in sediment or the soil in or around these streams should be done in accordance with DOE 5400.5 Section II.5 and Chapter IV requirements.

if they exist. Similarly, dose assessments to characterize release impacts and demonstrate compliance with DOE 5400.1 and DOE 5400.5 must consider contributions from these sources if they exist.

DOE 5400.5 prohibits new or increased discharges to active or new soil columns (Section II.3.b(2)). Any exception to this requirement under Section II.3.e(1) (i.e., an interim control strategy) requires program office and EH approval.

The plan for interim use of soil columns must be reviewed and updated annually. It is noted that DOE 5400.5 designates responsibility for initial and annual review of the plan and for approving it to the Field Office Manager. However, coordination of reviews and approval must be consistent with requirements contained in DOE SEN 6 and subsequent revisions. DOE 5400.5 also permits incorporation of the subject interim plans into DOE 5820.2A waste management plans. However, EH has been informed that in some cases, the requirement for waste management plans have been waived because other similar documents meet the same goals. In these situations, facilities should have a separate approved soil column interim-use plan and phaseout schedule as required in Section II.3.e(1) and must reevaluate that plan and schedule at least every 2 years. If the soil column plan has been incorporated into a EM plan designated as the equivalent to the 5820.2A waste management plan, its approval and reevaluation must be in accordance with Section II.3.e(1).

Section II.3.c prohibits liquid discharge into inactive soil columns, drainage systems (i.e., drainage fields and natural ground-water drainage systems) and ground water. This is intended to protect ground water contaminated by soil columns from further degradation and to prevent the spread of contamination through the soil column itself in order to minimize future cleanup requirements. It is not applicable to surface discharges to streams or surface drainage systems whose sediment or soil contain radionuclides derived

from previous surface discharges. As noted previously, these areas are subject to Section II.3.a (see Section 2.0 of this guidance).

4.0 Sanitary Sewers, DOE 5400.5, Section II.3.d

Discharge of liquid effluent containing DOE-derived radionuclides to the sanitary sewers is permitted if the concentrations are less than those specified in Section II.3.d, which is equivalent to NRC 10 CFR Part 20 requirements. However, in order to ensure that such discharges are small, Section II.3.d(4), DOE activities that release radioactive material to the sewerage system will require a dose assessment to ensure that potential doses to plant operators are well below DOE 5400.5 dose limits. This analysis should also consider the likely end use of the sewerage sludge in its dose assessment as this represents a potential pathway of exposure to the public. It is noted that while not specifically stated in this section, the ALARA requirements of DOE 5400.5 (Section II.2) apply to this section of the Order as it does to all other sections. Furthermore, Section II.3.d(1) requires operators of the affected sewerage treatment plant to be notified if a DOE activity causes the discharge of liquids containing radionuclides from DOE nuclear activities to the sanitary sewer system.

Section II.d(3) describes requirements for discharges to DOE owned and operated sewerage treatment plants.

BAT is also required to reduce radionuclide concentrations in sanitary sewerage releases to levels below those defined in II.3.d if they would otherwise be exceeded.

5.0 Exceptions and Control Strategies, DOE 5400.5, Section II.3.e

If operations cannot comply with Section II.3 of DOE 5400.5, an exemption may be requested and granted if interim control strategies are in place that ensure that members

of the public do not receive doses in excess of 10 mrem EDE in a year (0.1 mSv/year) from the air pathway (i.e., complies with 40 CFR Part 61, Subpart H)⁵, all other pathways associated with the waste disposal are less than 25 mrem EDE in a year (0.25 mSv/year), and the requirements of the ALARA process have been met (DOE 5820.2A). The request for alternate control criteria and supporting documentation must be approved by the appropriate Program Office and by EH-1 before it can be implemented. The interim control criteria must be reevaluated at least every two years.

It is recognized in this section that there is no BAT for control of low concentrations of tritium and it is exempted. However, it is required that process alternatives be reviewed under the ALARA process to ensure that tritium releases are as low as reasonably achievable.

⁵ If radium-226 is a major constituent and there is potential for radon-222 to exceed 20 pCi/m²-sec (0.7 Bq/m²-sec) from the facility, 40 CFR Part 61 Subpart Q is also applicable.